

REMARKS

Claims 1-88 are pending, and claims 59-88 were withdrawn from consideration in an election. Claims 45-49, 51-53, and 55-58 are allowed. Claims 1-22 and 24-44 stand rejected. Objections were made to claims 1, 3, 4, 16, 20, 23, 31, 32, 34-36, 50 and 54. Claims 15, 34 and 37 have been amended to correct an error in chemical names, which is supported by paragraph 48 of the specification.

Claim Objections

In paragraph 2 of the Office Action, claim 1 was objected to because the words “the chain” were unclear as to which chain. The examiner suggested using “the resulting polymer chain,” and appropriate correction has been made.

Claims 3, 4, 16, 20, 23, 31, 35 and 36 were objected to for use of open-ended ranges. For example, claim 31 calls for “recovering a block copolymer . . . having a number average molecular weight greater than about 25,000.” The mere fact that a claimed range is open-ended does not render a claim indefinite. *See* MPEP § 2173.05(c). A “court held that a limitation defining the stretch rate of a plastic as ‘exceeding about 10% per second’ is definite because infringement could clearly be assessed through the use of a stopwatch.” MPEP § 2173.05(b) *citing W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983). The claim language “exceeding about 10% per second” is an open-ended range, and the Court of Appeals for the Federal Circuit held that the claim is definite. Applicants respectfully request the examiner to withdraw his objection to the use of open-ended ranges in claims 4, 31, 35 and 36.

Claims 3, 16, 20 and 23 also use open-ended ranges and include a choice between two equations depending on a value. Claims 3, 16, 20 and 23 have been amended to omit the word “about” and include a provision for “or equal to.” Applicants respectfully request that the examiner withdraw his objections to claims 3, 16, 20 and 23 because Applicants have amended the claims and because the Federal Circuit has held that a claim with an open-ended range can be definite.

In paragraph 4 of the Office Action, claims 31, 32, 35 and 36 were objected to for failing to specify the type of molecular weight in paragraph 4 of the Office Action. Appropriate correction has been made.

Claim 34 was objected to, and it was suggested that “wherein” should replace “using.” Claim 34 was amended accordingly.

Claims 50 and 54 were objected to for being in improper dependent form. Claims 50 and 54 have been amended to place them in independent form.

Claim Rejections

Visger Patent

In paragraph 10 of the Office Action, claims 1-3, 5-18, 20, 21, 24-26, 31, 33, 38, 42 and 43 were rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,531,547, issued to Visger et al. (“Visger”). In paragraph 12, claims 4, 19, 22, 27-37 and 44 were rejected under 35 U.S.C. 103(a) as being obvious in view of Visger.

Claims Are Not Anticipated By Visger

Claim 1 to the present invention calls for “heating styrene and an unsaturated cyclic anhydride (UCA) in the presence of a free radical initiator and a stable free radical.” Visger et al. summarize their invention as a “process comprising the steps, (a) polymerizing . . . at least one vinyl aromatic monomer to prepare a stabilized active polymer block . . . ; (b) adding at least one acrylic monomer . . . to the mixture of residual vinyl aromatic monomer and stabilized active polymer block of (a); and (c) further reacting the mixture of (b) using a free radical process to effect copolymerization of said monomers.” Visger, column 3, lines 47-63. The further disclosure in Visger is consistent with this summary, which requires more than one step to produce a copolymer of a “a poly (vinyl aromatic) block and . . . a poly (vinyl aromatic-co-acrylic) block.” Visger, column 3, lines 46-47.

Only one step is required to produce the copolymer of claim 1 to the present invention. Styrene and an unsaturated cyclic anhydride, such as maleic anhydride, are heated together in a single step with an initiator and a stable free radical to form a reaction mixture, which is cooled, and from which is recovered a block copolymer. Paragraph 62 of the published application for the present invention supports this contention, stating: “[t]he process just described can be regarded as a one chemical step process, since all the ingredients are charged at the beginning of the reaction, as opposed to other processes for building block copolymers, in which a second monomer mixture is added until the monomer mixture forming the first block is consumed.”

In the process of [the Visger] invention, from about 5 to about 95 mole % of the charge comprising the at least one vinyl aromatic monomer, preferably, from about 50 to about 80 mole %, is polymerized to prepare the stabilized active polymer block (A). To the mixture of A-block polymer and unreacted vinyl aromatic monomer is then added the at least one acrylic monomer and optionally, additional vinyl aromatic monomer which is then further reacted to form the (vinyl aromatic-co-acrylate) (B) block.

Visger, column 9, lines 6-13.

Visger clearly requires at least two steps to make a block copolymer, while claim 1 to the present invention requires only a single step to make a block copolymer. Thus, Visger does not anticipate claim 1 of the present invention because claim 1 requires only one step, and Visger discloses a process that requires more than one step. Claims 2-3 and 5-14 depend directly or indirectly from claim 1, and because Visger does not anticipate claim 1, Visger does not anticipate claims 2-3 and 5-14.

Independent claims 15, 17, 21, 31 and 38 of the present invention also call for reacting styrene and an unsaturated cyclic anhydride together in a single step. These independent claims are not anticipated by Visger for the same reasons that Visger does not anticipate claim 1. Claims 16, 18, 20, 24-26, 33, 42 and 43 depend from one of these independent claims, and because the independent claims are not anticipated by Visger, these dependent claims are not anticipated by Visger.

Claims Are Not Rendered Obvious By Visger

Claims 4, 19, 22, 27-37 and 44 were rejected on the basis of obviousness in view of Visger. Claim 4 depends directly from claim 1. Claim 1 is not anticipated by Visger because claim 1 is a one-step process while Visger requires more than one step. For the process of claim 1, claim 4 provides that "the value of the molar ratio of stable free radical to initiator is at least about $1.3 + 0.10 * (\text{weight percentage of UCA with respect to total monomers})$." Visger does not teach or suggest a one-step process for reacting styrene and an unsaturated cyclic anhydride. Because Visger does not render obvious claim 1 of the present invention, Visger cannot render obvious claim 4 because it depends from claim 1. Further, Visger does not teach or suggest varying the ratio of stable free radical to initiator depending on the weight percentage of

unsaturated cyclic anhydride, and for this further reason, Visger does not render obvious claim 4 of the present invention.

Similarly, claim 17 is not anticipated by Visger because claim 17 heats styrene monomer and an unsaturated cyclic anhydride together in a single step while Visger requires more than one step. Claim 19 depends from claim 17 and states "further comprising providing a molar ratio of stable free radical to initiator of about: $1.3+0.10*(\text{weight percentage of unsaturated cyclic anhydride with respect to total monomers})$." Again, Visger does not teach or suggest varying the ratio of stable free radical to initiator with the weight percentage of unsaturated cyclic anhydride. Consequently, Visger does not render obvious claim 19 of the present invention.

Visger does not disclose, teach or suggest "heating styrene and unsaturated cyclic anhydride in the presence of a solvent, a free radical initiator and a stable free radical," which is the essence of independent claim 21. Claims 22 and 27-30 depend from claim 21, and because claim 21 is neither anticipated by nor rendered obvious by Visger, claim 22 is not rendered obvious by Visger. Similar, but repetitive, arguments can be made with respect to claims 31-37 and 44, and thus, it is respectfully submitted that these claims are not rendered obvious by Visger.

Claims Are Not Anticipated By Park

In paragraph 11 of the Office Action, claims 1-14, 17-21, 33 and 38-41 were rejected as being anticipated by a paper cited as Park et al., "Living Radical Copolymerization of Styrene/Maleic Anhydride," J. Polym. Sci., Part A: Polym. Chem., 38, 2239 (2000) (hereinafter referred to as "Park"). Applicants addressed the Park reference in paragraph 71 of the present application and state that Park does not disclose "conditions to attain sufficiently large molecular weights needed for polymer compatibilization." Applicants further state in paragraph 71 that "[a]fter extensive experimentation . . . , it was found that the ratio of nitroxide radical to initiator is an important parameter for obtaining the desired control of the polymerization leading to well defined block copolymer structures, and that this ratio depends on the amount of maleic anhydride that is to be copolymerized. The ratio of nitroxide radical to initiator (molar basis) should be varied from about 1.3 to about 2.5 or more in order to obtain control."

Applicants also disclosed and discussed Park in paragraph 11 of the present patent application, which states that the process disclosed by Park can only achieve a number average

molecular weight of 23,500 after 20 hours of reaction time. The Park paper notes that “[r]ecent studies [footnoted] reported that narrow polydispersity resins could be synthesized by a stable free-radical polymerization (SFRP) process by using nitroxide free radicals such as . . . (TEMPO) [footnoted] . . . However, long reaction time and low molecular weight limited the usefulness of this reaction for industrial applications.” Park, pg 2239, 2d ¶. Thus, Park recognized that sufficiently large molecular weights had not been achieved.

Park studied the “effects of MA [maleic anhydride] concentration on the SFRP for styrene/MA copolymerization.” Park, pg 2240, 2d ¶. Park found that “molecular weight of the copolymers [of styrene and MA] increased with MA concentration up to 5.0 mol % and then leveled off.” Park, pg 2241, 1st ¶. Park’s Table 1 shows number average molecular weight increasing to a maximum of 23,500 for styrene/MA copolymer at a concentration of 5.0 mol % MA and then reducing to 22,500 and 22,900 for 9.6 and 17.5 mol % MA, respectively, at 20 hours of reaction time.

Claim 1 to the present invention has been amended such that the polymer chain resulting from the process has a number average molecular weight greater than about 25,000. Claim 1 to the present invention thus has a minimum number average molecular weight of about 25,000, which is greater than the maximum number average molecular weight of 23,500 achieved by Park. Park thus does not anticipate claim 1 to the present invention. Claims 2-14 depend directly or indirectly from claim 1, and since Park does not anticipate claim 1, Park does not anticipate the claims that depend from claim 1.

Claim 17 was also amended and now has a number average molecular weight between about 25,000 and about 200,000. Since Park has a maximum number average molecular weight of 23,500 and claim 17 to the present invention has a minimum number average molecular weight of about 25,000, there is no overlap in the range. Claims 18-20 depend from claim 17. Consequently, Park does not anticipate claims 17-20 because the maximum molecular weight of Park is less than the minimum molecular weight of claims 17-20.

Similarly, claim 21 was amended and now has a polymer number average molecular weight ranging between about 25,000 and about 200,000. Park does not anticipate claim 21 because the minimum molecular weight for claim 21 is greater than the maximum molecular weight that Park was able to achieve.

Paragraph 11 of the Office Action states that Park anticipates claim 33, but claim 33 depends from independent claim 31. However, claim 31 was not said to be anticipated by Park. Claim 33 cannot be anticipated by Park because the independent claim from which it depends is not anticipated by Park.

Claim 38 was also amended to have a number average molecular weight of the resulting polymer of greater than about 25,000. Claims 39-41 depend from claim 38. Park does not anticipate claims 38-41 because the minimum molecular weight for these claims is greater than the maximum molecular weight disclosed by Park.

Rejoinder

Applicants respectfully request rejoinder of some or all of the withdrawn claims because the search that the examiner performed for the process claims is the same as the search needed for the composition claims. For example, claim 59 is directed to a block copolymer composition, comprising: a) a first block comprising random copolymer of styrene and an unsaturated cyclic anhydride having a total length between about 1 and about 720 monomeric units; and b) a second block comprising an essentially pure polystyrene block having a length between 100 and 2000 monomeric units, wherein c) the polydispersity is between about 1.2 and about 3.0.

This claim can be examined in view of the prior art the examiner cited in the Office Action of March 1, 2006. The same is true for many, if not all, of the other withdrawn claims. Consequently, Applicants respectfully request the examiner to rejoin and examine the withdrawn claims.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants respectfully request reconsideration and allowance of all of the pending claims, which are not withdrawn. Applicants further respectfully request rejoinder and examination of the withdrawn claims.

Respectfully submitted,

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